Zootaxa 3314: 45–57 (2012)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Taxonomy and distribution of the genus *Eurydice* Leach, 1815 (Crustacea, Isopoda, Cirolanidae) from the Arabian region, including three new species

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Abstract

Three new subtidal species of *Eurydice* are described, i.e. *Eurydice tridentata* **sp. nov**. and *Eurydice marisrubri* **sp. nov**. from the Red Sea, and *Eurydice marzouqui* **sp. nov**. from the Arabian/Persian Gulf. These species can be separated from all other *Eurydice* in the Arabian region by the absence of robust setae on the posterior margin of the pleotelson. *E. marisrubri* has a truncate posterior margin bearing 5 apical teeth, *E. marzouqui* has a rounded pleotelson posterior margin with 6 apical teeth and in *E. tridentata* the posterior margin is truncate, bearing 7 apical teeth, the central 3 prominent. Additional information is provided for two previously described species: *E. peraticis* Jones, 1974 and *E. arabica* Jones, 1974. Previous records of *E. inermis* are attributed to *E. tridentata* and *E. inermis* is excluded from the region. A key is provided to separate all the *Eurydice* species likely to be found in the Arabian region. The distribution of all the Arabian *Eurydice* is described, and morphology is discussed in relation to habitat.

Key words: taxonomy, Isopoda, *Eurydice*, Arabian Sea, /Persian Gulf, Red Sea

Introduction

The isopod fauna of the Western Indian Ocean are now reasonably well known (Kensley 2001), and Cirolanidae have been recently reviewed with descriptions of new species including several from the Arabian Gulf (Schotte & Kensley 2005). Similarly isopods of the Mediterranean region are well known (Hansen 1905; Monod 1930; Jones 1969; Dexter 1986/87). In contrast there are few recent studies in the Red Sea (Monod 1933; Bruce & Jones 1978; Dexter 1989; Hobbins & Jones 1993).

Intertidal species of *Eurydice* Leach, 1815 were first described from Red Sea and Arabian Gulf sand beaches by Jones (1974), who also discussed the ecology of *E. arabica* Jones, 1974 from the Red Sea and *E. peraticis* Jones, 1974 from the Gulf coast of Saudi Arabia. The range of *E. peraticis* was extended to the Goan coast of India (Eleftheriou & Jones 1976) and this species has also been recorded from the northern Arabian sea (Kazmi *et al*. 2002). A second Indian species *E. indicis* Eleftheriou and Jones, 1976, occurs on coarse sand beaches in the south at Kerala, and is included in the key although it has yet to be found in the Arabian region. A third intertidal species *E. paxilli* Schotte and Kensley, 2005 was recently described from the Gulf coast of Saudi Arabia.

The only subtidal species of *Eurydice* previously recorded from the region was *E. inermis* Hansen, 1890, although the diagnosis of this Red Sea species was acknowledged to be tentative (Bruce & Jones 1978; Bruce 1986). Comparison of original material from Yanbu, Saudi Arabia, with present material from near Eilat, Israel confirms that this is a new species, *E. tridentata* sp. nov. Two further subtidal species of *Eurydice* are here described, *E. marisrubri* **sp. nov.** from material collected by Professor Lev Fishelson off Eilat, Red Sea, and *E. marzouqui* **sp. nov.** from Kuwait and Tarut Bay, Saudi Arabia.

A key is provided to the species of *Eurydice* and their morphology in relation to habitat is discussed.

Accepted by J. Svavarsson: 2 Apr. 2012; published: 16 May 2012

Material and methods

Freshly collected material was obtained from Sabah Al-Ahmad Sea City waterways in the south of Kuwait and from Kuwait open sea beaches during the UNCC surveys (2002–2005). Additional material was donated from Saudi Arabian ARAMCO surveys (McCain 1984), and from collections made in the northern Red Sea by Professor L. Fishelson, Telaviv University (Fig. 1). Material described has been deposited in the Senckenberg Forschungsinstitute und Naturmuseum Frankfurt, Germany (SMF) where extensive collections of Arabian Gulf crustaceans are held.

All material was preserved in 5% buffered formalin for 24h, and then transferred to 70% alcohol/30% glycerol. Specimens were dissected using a Wild M5 binocular microscope and mounted using polyvinyl lactophenol/lignin pink. Drawings were made from slides using a Reichert viewer. Descriptions follow the taxonomic data base system DELTA (Dallwitz 1980; Dalwitz *et al*. 2000).

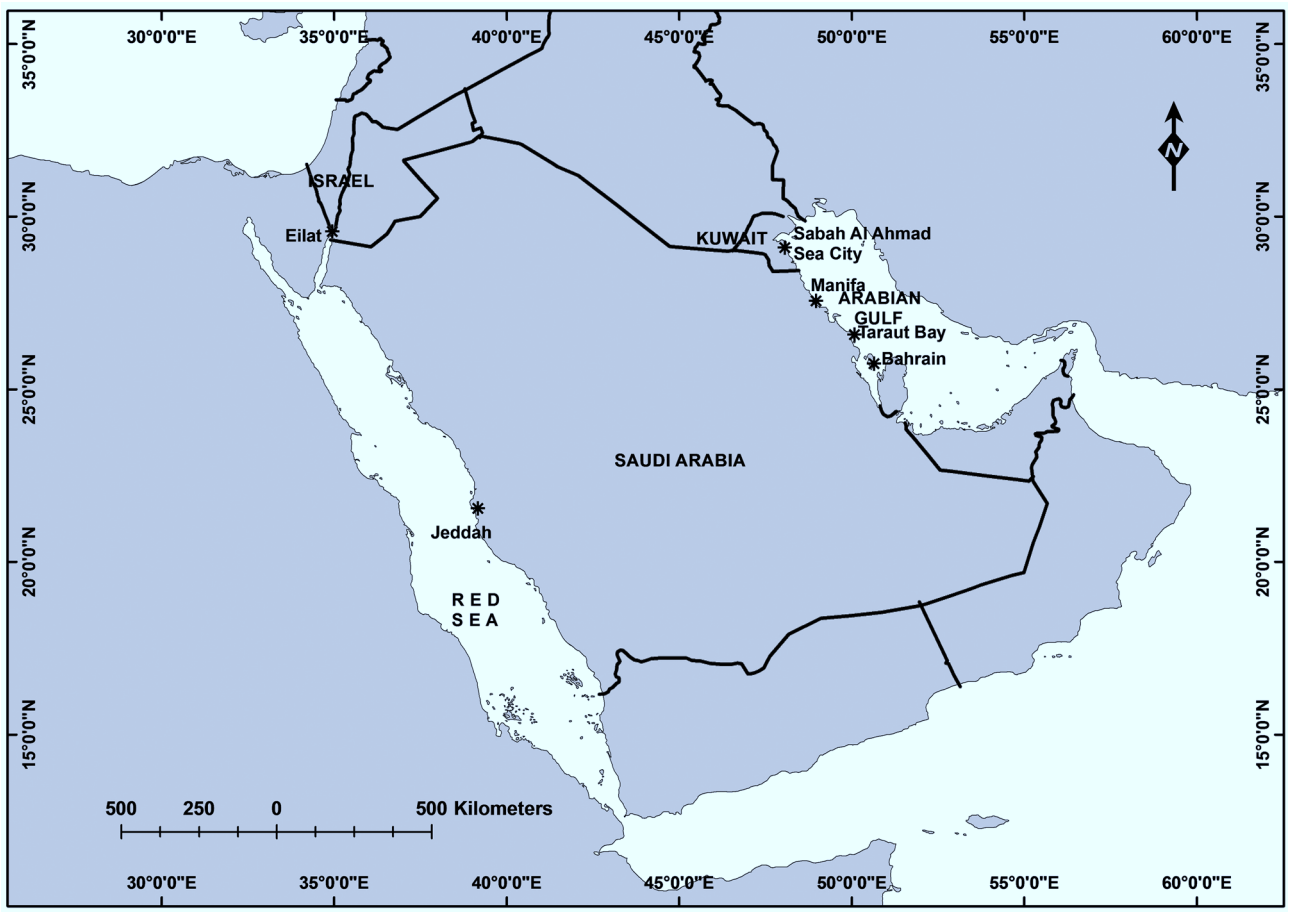

FIGURE 1. Map of the Arabian region showing collection locations for *Eurydice* species.

Systematics

Family Cirolanidae Dana 1852

Genus *Eurydice* Leach, 1815

Restricted synonymy. *Eurydice* Leach 1815: 354, 370.—Jones, 1971: 201.—Bruce 1986: 11.—Brusca *et al*. 1995: 40.—Schotte & Kensley 2005: 1232.
Type species: *Eurydice pulchra* Leach 1815, by monotypy.

Remarks: Recent diagnoses to the genus have been given by Bruce (1986), Brusca *et al*. (1995), Kensley and

Schotte (1989) and Schotte and Kensley (2005). The genus can be identified by the geniculate antennule peduncle which has article 2 at right angles to article 1; in all species pleonite 5 has completely free lateral margins. The antennal peduncle is 4-articulate, the frontal lamina is reduced and the clypeus projects ventrally. The maxilliped endite lacks coupling hooks, and the appendix masculina is inserted medially. The uropod rami do not project beyond the pleotelson apex. Further information on the diversity and distribution of the genus is given in the distribution section.

Keys to Australian and Indian Ocean species may be found in Bruce (1986) and Schotte and Kensley (2005) respectively, while Bruce and Soares (1996) provide a key for South African species. The present work provides a key to *Eurydice* found in the Arabian region.

Key to species of *Eurydice* from the Arabian region

1. Uropod endopod twice or almost twice (1.8–2.3) width of exopod and exceeding length of exopod by up to 1.25 times; posterior margin of pleotelson with 2 or 4 robust setae 2
- Uropod endopod less than twice (1.5–1.7) width of exopod and exceeding length of exopod by over 1.4 times; posterior margin of pleotelson without robust setae at most simple or plumose setae. 5
2. Antennal flagellum reaching at least to pereonite 5, antennal peduncle article 3 with 6–17 setae; posterior margin of pleotelson with 4 robust setae 3
- Antennal flagellum reaching only to mid-length of pereonite 1; antennal peduncle article 3 with 5 setae; posterior margin of pleotelson with 2 robust setae . . . . . ***Eurydice paxilli***
3. Antennal flagellum not reaching beyond pereon; antennal peduncle article 3 with 6–9 setae; posterior margin of pleotelson with 4 robust setae. 4
- Antennal flagellum reaching beyond second pleonite; antennal peduncle article 3 with 17 setae; posterior margin of pleotelson narrow with 4 robust and 8 simple setae. . . . . ***Eurydice indicis*** (India not Arabian region as yet)
4. Antennal flagellum reaching to mid seventh pereonite; posterior margin of pleotelson one third of pleotelson width with 4 robust setae and circa 15 plumose setae . . . . . ***Eurydice peraticis*** (India and Arabian Gulf)
- Antennal flagellum reaching fifth pereonite; antennal peduncle article 3 with 6 setae; posterior margin of pleotelson one fifth of width of pleotelson width with 4 robust setae and 6 plumose setae. . . . . ***Eurydice arabica*** (Red Sea–Arabian Gulf)
5. Antennal flagellum reaching mid pleon or beyond; peduncle article 3 with 5 setae; pleotelson posterior margin truncate without robust setae but with 6 plumose and 2 simple seta; tip of appendix masculina pointed. 6
- Antennal flagellum reaching end of pereon; pedunclular article 3 with 3 setae; pleotelson posterior margin slightly rounded without robust setae but with 6 plumose and 8 simple setae; tip of appendix masculina blunt . . . . . ***Eurydice marzouqui* sp. nov.** (Arabian Gulf)
6. Antennal flagellum reaching pleonite 2, antennule flagellum reaching pereonite 1; hind margins of pleonites serrated; pleotelson posterior margin with 5 equal apical teeth; appendix masculina with lateral terminal point . . . . . ***Eurydice marisrubri* sp. nov.** (Red Sea)
- Antennal flagellum reaching beyond mid pleotelson, antennule flagellum reaching pereonite 3, hind margins of pleonites smooth; pleotelson posterior margin with 7 apical teeth, central 3 pronounced; appendix masculina with terminal point straight . . . . . ***Eurydice tridentata* sp. nov.** (Red Sea)

Eurydice marzouqui sp. nov.

(Figs 1, 4a–c)

Material examined. Holotype. Male 3.4 mm, (SMF 34840): sta. 5G-3 Tarut Bay, Saudi Arabia, seagrass beds, coll. J. McCain, 11 June 1984.

Paratypes: 1 male (SMF 34841): Sabah Al-Ahmad Sea City Waterways, Kuwait, ichthyoplankton, coll. B. R. Sontakke, 12 May, 2008. 2 females (SMF 34842) sta 7RG off Manifa, Saudi Arabia, seagrass beds, coll. S.M. Ali, Feb. 1986.

Description. Male holotype: *Body* 2.9 times as long as greatest width at pereonites 4 and 5. *Cephalon* anterior margin evenly rounded, eyes small with 7 ocelli horizontally and 6 vertically. *Coxae* 2–7 with acute angles at posterolateral margins. *Pleonites* of equal length, pleonite 1 slightly concealed by posterior margin of pereonite 7. Ventral margins of pleonites 2–5 acute, posterior dorsal margin of pleonite 5 sinuous, centrally convex. *Pleotelson* as broad as long, anterior margin 5 times width of posterior margin, which is slightly rounded, and bears 6 apical teeth, 8 simple setae and 6 plumose setae.

Antennule barely reaching mid-point of eye, flagellum of 4 articles, article 1 longer than combined length of articles 2–4. *Antenna* peduncle reaching to pereonite 1; article 1 with 2 setae on anterodistal angle, article 3 with 3 anterodistal setae; article 4 longer than articles 2 and 3 combined; flagellum of 21 articles reaching posterior margin of pereonite 7; flagellum terminal seta is 0.2 length of flagellum.

Mandible spine row with 5 spines; molar process anterior margin with 14 spines. Terminal article of mandibular palp twice as long as broad, with 8 setae. *Maxillule* lateral lobe with 13 robust setae on gnathal surface, medial lobe with 3 stout circum plumose setae and 2 simple setae. *Maxilla* lateral lobe with 3 setae, middle lobe with 3 setae and medial lobe with 3 plumose and 2 simple setae. *Maxilliped* palp with all articles entire, terminal article with 6 simple setae; endite with 1 plumose and 2 simple setae.

Pereopods 1–3 sparsely setose, pereopod 1 and 3 figured. Pereopod 1 with robust seta opposing dactylus half length of dactylus; posterior margin of ischium with 2 robust setae; merus with single anterodistal robust seta and 2 simple setae. Pereopod 2 similar but with robust seta opposing dactylus only one third length of dactylus. No robust setae on posterior margin of ischium and 3 simple setae only on anterodistal margin of merus. Pereopod 3 with 4 robust setae on the posterodistal margin of propodus and 2 robust setae on posterior margin; merus with 4 posterodistal robust setae; carpus with 3 posterodistal and 2 on the posterolateral margin. Ischium with 3 posterodistal and 2 groups of 2 robust setae on posterior margin; basis with 4 simple setae on posterodistal angle. Pereopod 7 sparsely setose, propodus anterior margin with 6 robust and 1 simple seta; posterior margin with 3 robust and 2 simple setae. Merus with 5 robust and 3 simple setae on anterior margin; posterior margin with 4 robust setae. Carpus with 4 robust and 4 simple setae on anterior margin and 4 robust setae on posterior margin. Ischium with 3 robust and 2 simple setae on anterior margin and 2 robust setae on posterior margin.

Pleopod 1 with rami subequal in length, exopod with 17 plumose setae, endopod with 11, exopod 1.5 times wider than endopod. Pleopod 2 exopod and endopod with 17 and 15 plumose setae respectively. *Appendix masculina* of even width, distally straight, apex rounded, appendix masculina 0.7 as long as endopod, projects beyond endopod by one tenth of its length. *Uropod* endopod 1.4 times length of exopod, bearing 9 plumose setae on posterior margin and 5 simple setae on lateral margin. Exopod ovate with 4 simple setae on lateral margin and 6 plumose and 3 simple setae on posterior margin. Both rami do not reach pleotelson posterior margin.

Female: As for male but body broader, antennae shorter reaching posterior margin of pereon segment 5.

Colour. Translucent with black chromatophores on dorsal surface of cephalon, pereon and pleon, extending onto ventrolateral surfaces of pleon.

Remarks. The slightly rounded posterior margin of the pleotelson with 6 equal sized apical teeth and an absence of robust setae, combined with straight appendix masculina, with a blunt unornamented apex, are the characters which diagnose *E. marzouqui* **sp. nov.** This is the first subtidal species to be recorded from the Arabian Gulf and it is separated from the intertidal species *E. peraticis* and *E. paxilli* by the absence of robust setae on the posterior margin of the pleotelson. The absence of robust setae, together with a narrow posterior pleotelson margin, are common features amongst subtidal *Eurydice* species, but *E. marzouqui* may be separated from all others by the number of apical teeth, plumose setae and appendix masculina shape. Only *E. tarti* Bruce 1986 has a similar rounded apex to the appendix masculina, but in *E. tarti* the appendix masculina is curved and the posterior margin of the pleotelson is acute. The appendix masculina of *E. inermis* from Greece is reproduced in Figure 5 to show that, unlike that of *E. marzouqui*, it broadens towards the apex which is triangular.

Etymology. This species is named for Fawaz Al-Marzouq who created the Sabah Al-Ahmad Sea City in whose waterways *E. marzouqui* was discovered.

***Eurydice tridentata* sp. nov.**

(Figs. 2, 4d–f)

Eurydice inermis. Bruce & Jones 1978: 397, fig. 6h (not *E. inermis* Hansen, 1890).

Material examined. Holotype. Male (SMF 34843): sta. RS112 near Eilat, Israel, Red Sea, ichthyoplankton, coll. L. Fishelson, 4 Feb. 1985.

Paratypes: 3 males, 2 females (SMF 34844): sta. RS112 near Eilat, Israel, Red Sea, ichthyoplankton, coll. L. Fishelson 4 Feb. 1985, same locality as type material 3 males, 2 females R138 (SMF 39703), R20 1 male (SMF 39704), RS136 1 male, 3 females, juv. (SMF 39705) coll. L. Fishelson, 1986.

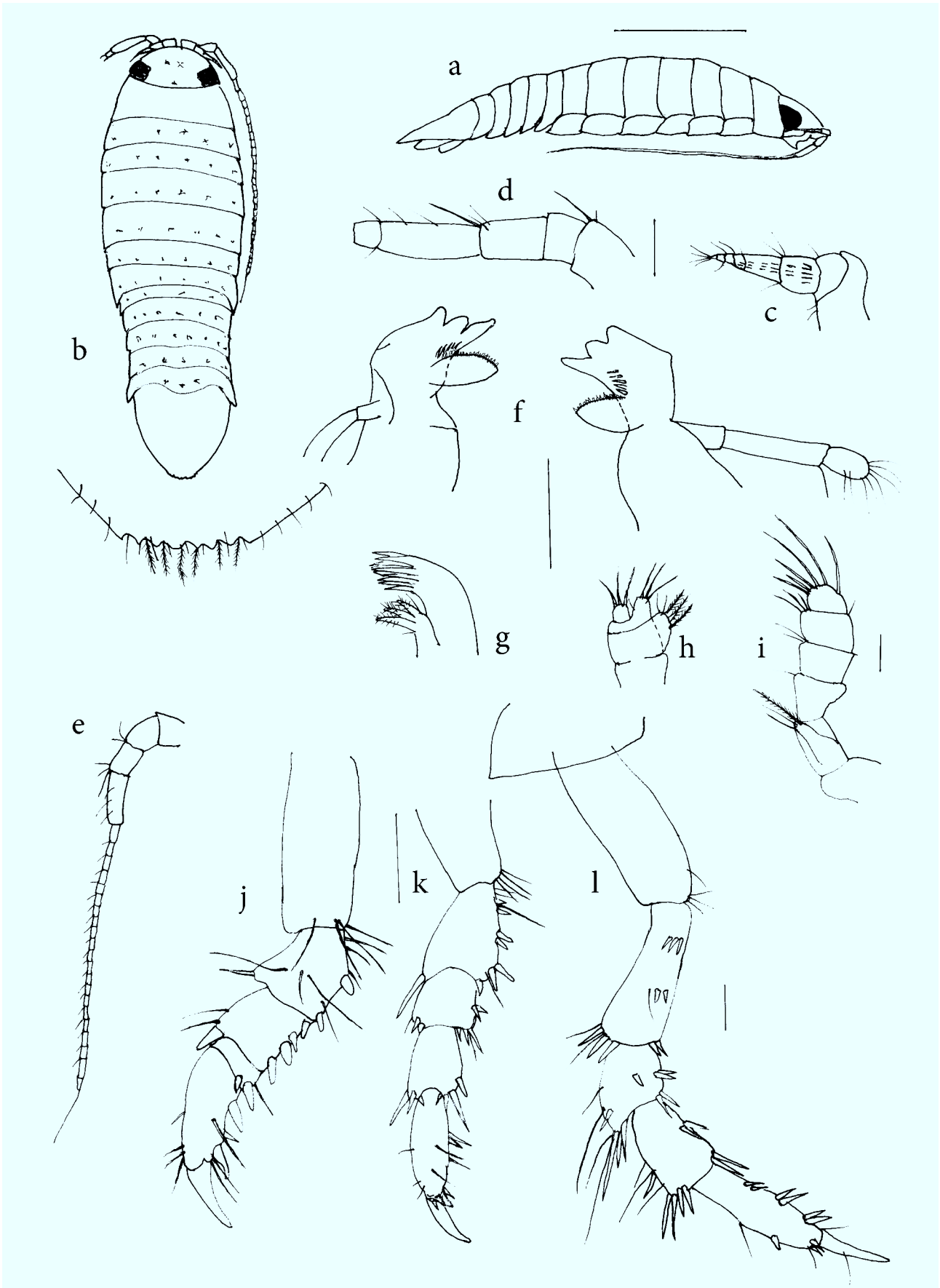

FIGURE 2. *Eurydice marzouqui* **sp. nov.** Holotype (SMF 34840): a, b, paratype (SMF 34841) ♂: c–1. a, lateral view; b, dorsal view; c, antennule; d, antennal peduncle; e, antenna; f, mandibles; g, maxillule; h, maxilla; i, maxilliped palp; j, pereopod 1; k, pereopod 3; l, pereopod 7. Horizontal scale = 1.0mm, vertical scale = 0.1mm.

Description. Male holotype: *Body*, 4.8 mm in length, 3.2 times as long as greatest width at pereonite 5. *Cephalon* anterior margin rounded, eyes well developed with 7 ocelli horizontally and 5 vertically. *Coxae* 2–7 with acute angles at posterolateral margins, those of 6–7 produced. *Pleonites* 2–5 equal in length, pleonite 1 narrow, half length of others. Ventral margins of pleonites 2–5 acute, posterior margin of pleonite 5 straight. *Pleotelson* 1.3 times wider than long and 4.6 times wider than posterior margin which is truncate and bordered by pronounced teeth. Posterior margin bears 7 apical teeth with the 3 central teeth pronounced; 6 plumose and 2 simple marginal setae are present.

Antennule reaching to posterior margin of pereonite 3, peduncle articles 2 and 3 subequal in length, each bearing a single seta on anterior margin; flagellum of 4 articles, article 1 equal in length to articles 2–4 combined; all articles bearing elongate aesthetascs; flagellar article 4 with 5 terminal setae, one of which is stiff and is twice the length of the combined antennular articles.

Antenna reaching to midlength of pleotelson; length of peduncular articles 1 and 2 combined just exceeds length of article 3; article 4 just shorter than combined length of articles 1–3. Article 2 anterodistal angle with 3 simple setae, article 3 with 3 setae and article 4 with 8 anterior marginal setae. Flagellum with 23 articles, proximal articles half the length of distal articles; each article with 2 long and 1 short setae on anterodistal angle and a plicate process on posteroproximal angle. Setae on article 21 over half length of article 22, terminal seta equal in length to last 3 flagellar articles.

Mandible spine row with 6 spines; molar process anterior margin with 17 spines. Terminal article of mandibular pulp 5 times as long as broad with 9 setae. Article 2 with 2 long setae on posterodistal angle, reaching beyond apex of palp. *Maxillule* lateral lobe with 13 spines on gnathal surface, medial lobe with 3 stout circumplumose setae and 2 simple setae. *Maxilla* as for other species in the genus (not figured). *Maxilliped* palp with all articles entire, terminal article of palp with 10 simple setae; endite with 1 plumose and 2 simple setae.

Pereopod 1 moderately setose with robust seta opposing dactylus half length of dactylus; posterior margin of ischium with 2 robust setae. Merus anterodistal angle without robust setae but with 9 simple setae; posterior margin with 5 robust setae. Pereopod 2 similar but with robust seta opposing dactylus only one third length of dactylus. Two robust setae on posterior margin of ischium and 4 on posterior margin of merus, anterodistal margin with no robust setae but 11 simple setae. Pereopod 3 with 2 robust setae on posterodistal margin of propodus; merus with 3 robust setae on posterodistal margin; carpus with 4 robust setae on posterodistal margin and 2 on posterolateral margin. Ischium with 4 robust setae on posterodistal margin and one group of 2 on posterolateral margin; basis with a single robust seta on posterodistal margin and 5 simple setae. Pereopod 7 setose, propodus anterior margin with 6 robust and 4 simple setae; posterior margin with 7 robust and 8 simple setae. Merus with 8 robust and 8 simple setae on the anterior margin and 7 robust and 16 simple setae on the posterior margin. Ischium with 6 robust setae and 9 simple setae on the anterior margin and 5 robust and 6 simple setae on the posterior margin.

Pleopod 1 endopod shorter and narrower than exopod; endopod with 25 and exopod with 30 plumose setae; exopod 1.25 times wider than endopod. Pleopod 2 exopod with 25 and endopod with 21 plumose setae. *Appendix masculina* of even width, slightly curved, terminating in a strong pointed process, distal third covered with microtrichs and extending beyond apex of endopod by one fifth of its length. *Uropod* endopod 1.3 times length of exopod bearing 10 plumose setae on posterior margin and 6 simple setae on lateral margin; exopod triangular with posterior margin straight and 6 setae on laterodistal angle and 7 plumose setae plus 2 simple setae on posterior margin; extending to posterior margin of pleotelson.

Female: As for male but body broader, antennule shorter reaching posterior margin of pereonite 2; antenna shorter, reaching posterior margin of pereonite 4.

Colour. Brown in alcohol with large black chromatophores on dorsal surface of body and ventrolateral surfaces of pleonites 1–3.

Remarks. The truncate posterior margin of the pleotelson has 7 apical teeth, central 3 prominent, no robust setae, but 6 plumose and 2 simple setae. These characters together with the appendix masculina with a straight pointed apex diagnose *E. tridentata* **sp. nov.** Comparison of present material with Bruce & Jones (1978, fig 6h) *Eurydice ?inermis* shows that the appendix masculina of material from Yanbu, Saudi Arabia is similar to that of *E. tridentata* and not *E. inermis* Hansen. The rounded posterior pleotelson margin with 6–9 apical teeth, shorter length of antennae and absence of flagellar plicate processes in *E. inermis* further separates this species from *E. tridentata.* The only other species with a truncate pleotelson posterior margin and male antennae reaching the pleotelson is *E. orientalis* Hansen, 1890. Although the pleotelson posterior margin dentition of this species (Bruce 1986) is very

similar to that of *E. tridentata*, the three central teeth are prominent in *E. tridentata* and only 6 plumose and two simple setae are present. The terminal process of the appendix masculina is angled and blunt in *E. orientalis*, but straight and pointed in *E tridentata*. In *E. orientalis* the antennule flagellum reaches no further than pereonite 1, but reaches pereonite 3 in *E. tridentata*, and the antennal flagellum reaches the mid pleotelson in *E. tridentata* but reaches the end of the pleotelson in *E. orientalis*.

Etymology. The specific name recognises the pronounced three central teeth on the pleotelson posterior margin.

***Eurydice marisrubri* sp. nov.**
(Figs 3, 4)

Material examined. **Holotype**. Male (SMF 34845): sta. RS237, 2 km off Eilat, Israel, Red Sea, neuston coll. L. Fishelson, 21 Oct 1986.

Paratypes: 3 Males, 2 females (SMF 34846): sta. RS112, near Eilat, Israel, Red Sea, ichthyoplankton, 50 males and females juv. (SMF 39706), near Eilat, Israel, Red Sea. Sta. R26, coll. L. Fishelson, 1985–1986.

Description. Male holotype *body* 3.7 mm in length, 2.9 times longer than greatest width at pereonites 4and 5. *Cephalon* anterior bluntly rounded, eyes large with 7–8 vertical and 6–7 horizontal ocelli. *Coxae* 2–7 with slightly produced acute posterolateral lateral margins. *Pleonites* 2–5 with crenulated posterior margins, ventral margins of all pleonites acute. *Pleotelson* with lateral margins crenulate, slightly broader than long and 4.4 times wider than the posterior margin which is truncate. Posterior margin with 5 subequal teeth, 6 plumose setae and 2 submarginal setae.

Antennule reaching to posterior edge of eye, third peduncular article longest bearing 4 simple setae on anterodistal angle. Flagellum of 4 articles with article 1 equal in length to combined articles 2–4. Terminal article with 6 setae, one of which is more than twice length of others.

Antenna reaching to posterior margin of pleonite 3 length of peduncular articles 2 and 3 equal to length of peduncular article 4. Peduncular article 3 with 4 setae on anterodistal margin and 1 seta on posterodistal angle. Peduncular article 4 with 2 single setae and 2 groups of 2 setae on anterior margin and 2 setae on posterior margin. Flagellum of 14 articles, distal articles twice length of proximal, each with 2 setae on anterodistal margin; no plicate processes present. Two terminal setae present, one 8 times, one 3 times length of distal article.

Mandible spine row with 6 spines, molar process anterior margin with 14 spines. Terminal article of mandibular palp 2.4 times longer than wide bearing 7 setae, article 2 with a single seta. *Maxillule* lateral lobe with 13 robust setae on gnathal surface, medial lobe with 3 circumplumose setae and a single simple seta. *Maxilla* lateral lobe with 4 terminal setae, middle lobe with 4 setae and medial lobe with 3 simple and 1 plumose setae. *Maxilliped* palp with all articles entire, terminal article broader than long with 6 setae; endite with a single plumose seta and short simple seta.

Pereopods 1–3 moderately setose, all figured. Pereopod 1 with robust seta opposing dactylus half length of dactylus, posterior margin of ischium without robust setae and a single simple seta; merus without anterodistal robust seta but 3 simple setae. Pereopod 2 with 2 robust and 6 simple setae on ischium posterior margin; merus with anterodistal robust seta and 6 simple setae. Pereopod 3 with 2 robust setae on the posterodistal margin of the propodus and a single robust seta on the posterior margin; carpus with 4 posterodistal robust setae and a single robust seta on the posterior margin. Ischium with 4 robust setae on the posterodistal margin and a group of 3 and 2 robust setae on the posterior margin; basis with 3 simple setae, one reaching two thirds of length of ischium.

Pereopod 7 moderately setose, propodus anterior margin with 5 robust setae; posterior margin with 3 robust and 3 simple setae. Merus with 6 robust and 3 simple setae on anterior margin, posterior margin with 5 robust and 5 simple setae. Carpus with 3 robust and 2 simple setae on posterodistal margin and a single robust and simple seta on posterior margin. Ischium with 3 robust and 4 simple setae on anterior margin and 2 robust and 3 simple setae on posterior margin.

Pleopod 1 with exopod longer than endopod and 1·45 times wider, exopod with 17 plumose setae, endopod with 12 plumose setae. Pleopod 2 with 23 plumose setae on exopod and 17 plumose setae on endopod. *Appendix masculina* straight, slightly expanded distally with curved tip bearing a short blunt process. Microtrichs present on distal third of appendix masculina which extends beyond endopod by one third of its length. *Uropod* endopod 1·5

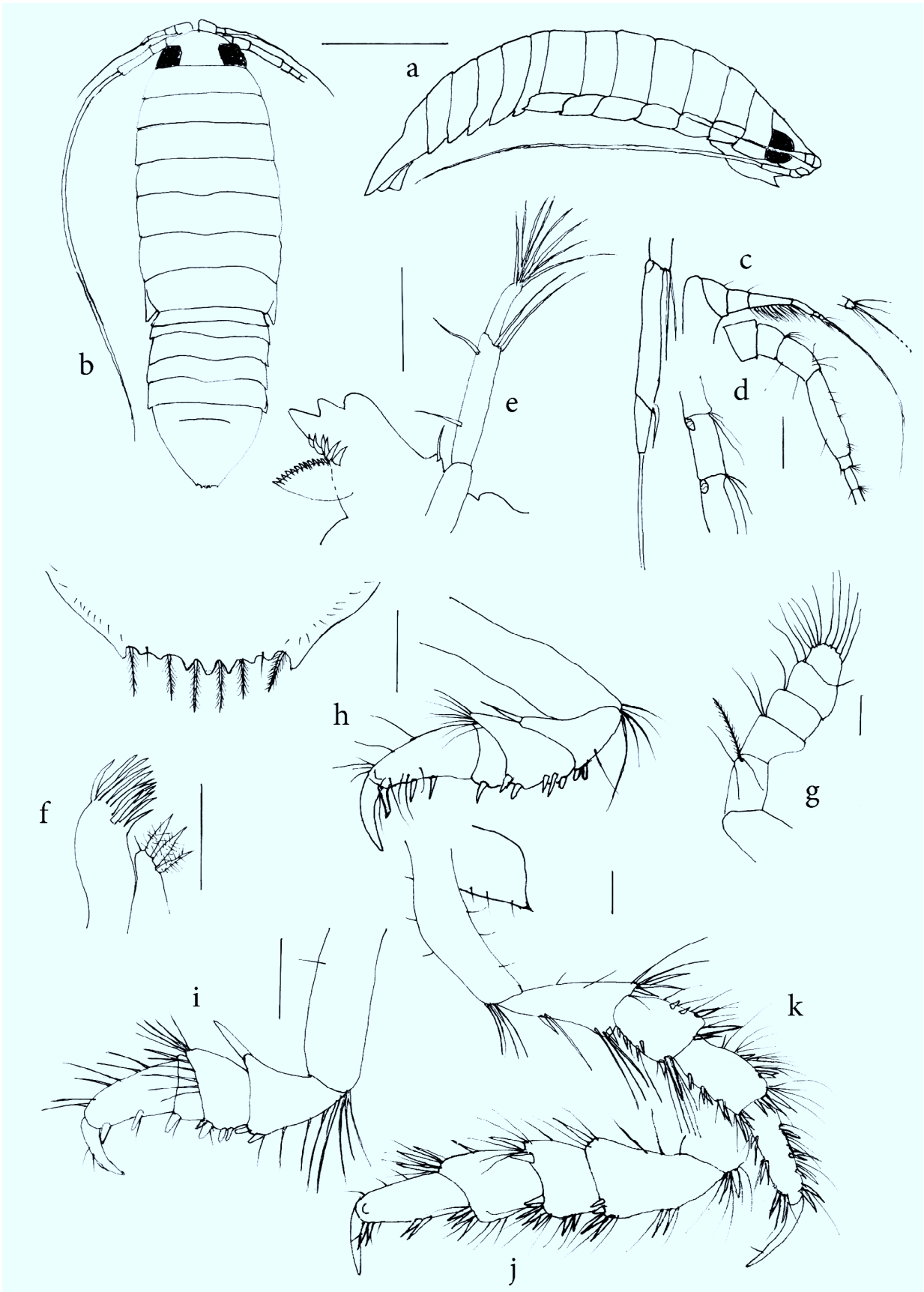

FIGURE 3. *Eurydice tridentata* **sp. nov.** Holotype (SMF 34843): a, b, paratypes (SMF 34844) ♂♀: c–k. a, lateral view; b, dorsal view; c, antennule, detail of terminal articles; d, antennal peduncle and detail of tip; e, mandible; f, maxillule; g, maxilliped palp; h, pereopod 1, i, pereopod 2; j, pereopod 3; k, pereopod 7. Horizontal scale = 1.0mm, vertical scale = 0.1mm.

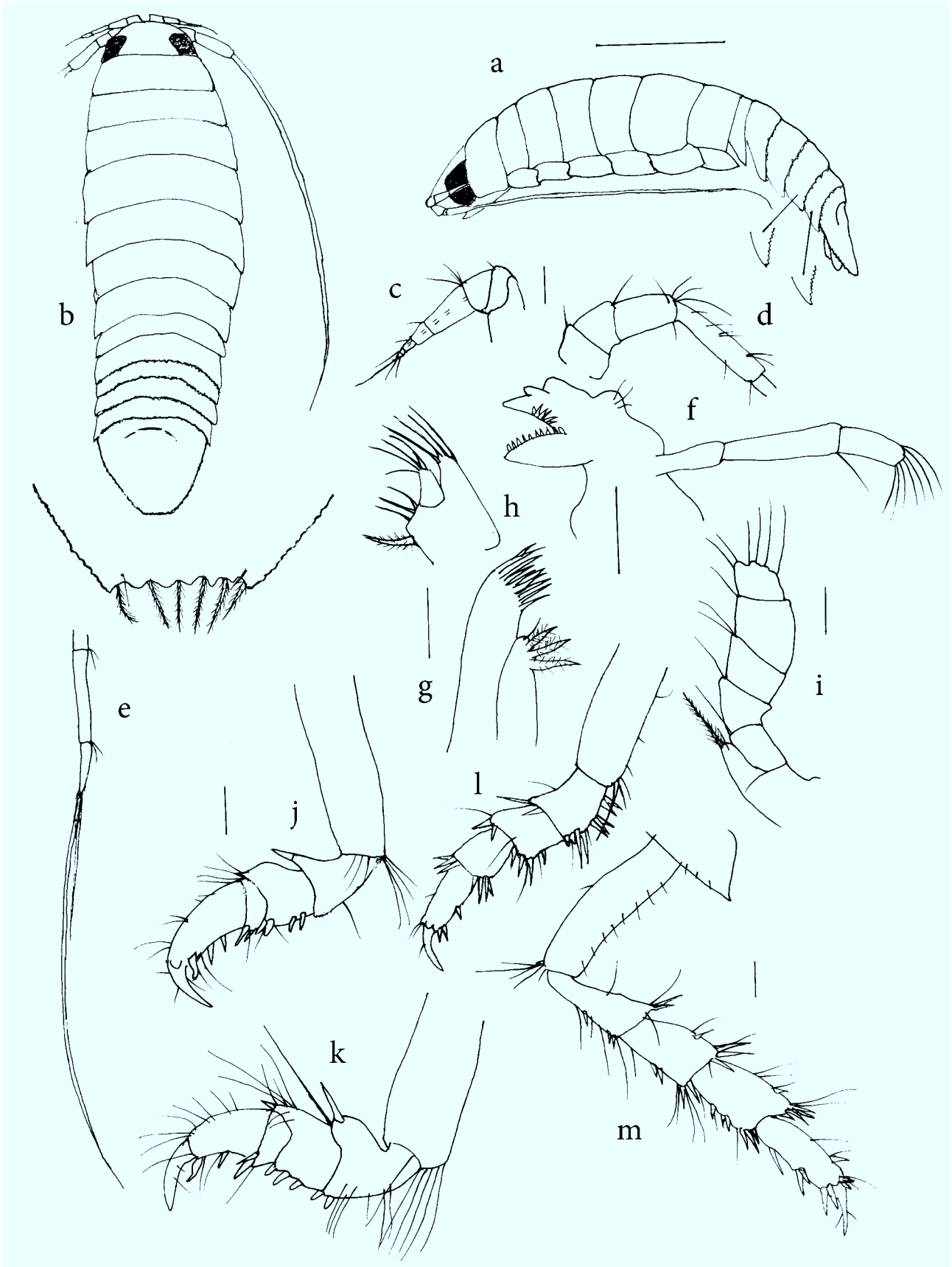

FIGURE 4. *Eurydice marisrubri* **sp. nov.** Holotype (SMF 34845): a, b, paratypes (SMF 34846) ♂♀: c–m. a lateral b, dorsal view; c, antennule; d, antennal peduncle; e tip of antenna; f mandible; g, maxillule; h, maxilla; i, maxilliped palp; j, pereopod 1; k, pereopod 2; l, pereopod 3; m, pereopod 7. Horizontal scale = 1.0 mm, vertical scale = 0.1mm.

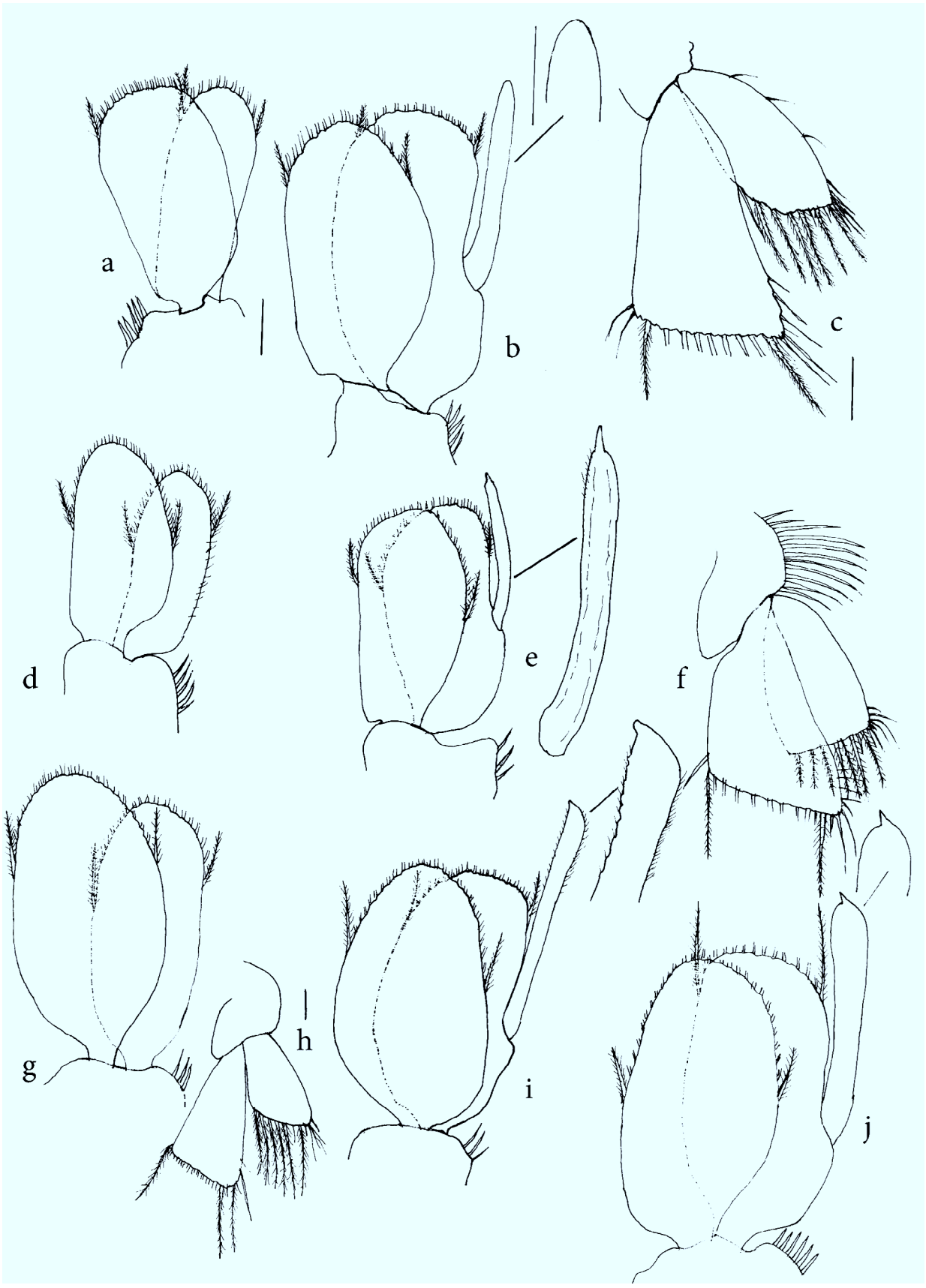

FIGURE 5. *Eurydice marzouqui* **sp. nov.** ♂ paratype (SMF 34841): a, pleopod l; b, pleopod 2 with appendix masculina; c, uropod. *Eurydice tridentata* **sp. nov.** paratype (SMF 34844): d, pleopod l; e, pleopod 2 with appendix masculina; f, uropod. *Eurydice marisrubri* (SMF 34846): g, pleopod 1; h, uropod; i, pleopod 2 with appendix masculina. *Eurydice peraticis* 4.0 mm ♂ (SMF 39707): j, pleopod 2 with appendix masculina. Horizontal scale = 1.0 mm, vertical scale = 0.1 mm.

times length of exopod, distinctly triangular in shape, bearing 13 plumose and 2 robust setae on posterior margin. *Exopod* with 5 simple setae and 1 robust seta on posterolateral angle and 6 plumose plus 2 robust setae on posterior margin. Rami do not reach posterior margin of pleotelson.

Female: As for male but body broader; antenna shorter reaching posterior margin of pereonite 5, terminal seta equal in length to terminal article of flagellum.

Colour. Brown in alcohol with small black chromatophores on dorsal surface of body but with no ventral pigmentation.

Remarks. The characters which diagnose *E. marisrubri* are the narrow truncate posterior pleotelson margin with crenulated lateral margins and 5 equal sized apical teeth and the absence of robust setae. In addition the crenulated posterior margins to pleonites 2–5 and straight appendix masculina with expanded apex and angled apical projection. This species is similar to *E. woka* Bruce, 1986, one of a group of subtidal Australian *Eurydice* (Bruce 1986). *Eurydice marisrubri* is separated by the presence of 6 plumose setae on the posterior margin of the pleotelson (*E. woka* has 4); the crenulated posterior margins of pleonites and pleotelson, together with the length and shape of the appendix masculina. These and other features separate *E. marisrubri* from *E. inermis, E. humilis* Stebbing (1910) and all other subtidal species.

Etymology. This species appears to be common and have a wide range in the Red Sea (Yanbu to Eilat) and is named after the sea which it inhabits.

Eurydice peraticis Jones, 1974

(Figs 4j, 5c)

Eurydice peraticis Jones 1974: 204, fig. 3a–g.—Eleftheriou & Jones 1976: 387.—Bruce 1986: 221.—Kazmi *et al.* 2002: 91, fig. 66a–g.

Material examined. 135 males and females juv. (SMF 39707) intertidal sand, Bahrain sta. 85085A2, coll. D.A. Jones 1985; 14 males and females juv. (SMF 39708), intertidal sand, Kuwait, sta. 5157–01, coll. D.A. Jones 2001.

Remarks. These large collections of *E. peraticis* include male specimens of up to 4.0 mm in length. Examination of the appendix masculina of adult males of 4.0 mm reveal that the appendix masculina has a distinct, pointed apical process, which was absent in the holotype described by Jones (1974). The holotype was 3.3 mm in length and may not have been fully developed, although pereopod 7 was fully setose. The appendix masculina of an adult (4.0 mm) male *E. peraticis* is shown in Fig. 4j together with the pleotelson posterior margin (Fig. 5c).

Eurydice arabica Jones, 1974

(Fig. 5a, b)

Eurydice arabica Jones 1974: 202, fig. 2a–g.—Bruce 1986: 221.

Material examined. 3 females (SMF 40852) low tide, subtidal sand, Bahrain sta. 850805A5, Mashtan Island, coll. D.A. Jones 1985; 1 juv (SMF 40853) subtidal sand, Kuwait, Al-Ahmad Sea City waterways, sta. NS06 coll. B.R. Sontakke 2009.

Remarks. This species has been extensively collected in the Red Sea (Jones 1974; Dexter 1986/7; Dexter 1989) from intertidal sand, but present records from Bahrain and Kuwait are the first for the Arabian Gulf.

The appendix masculina and pleotelson posterior margin are figured (Fig. 5a, b), together with those of *E. paxilli* (Fig. 5d, e) and *E. inermis* (Fig. 5f) to assist with the identification key.

Distribution

The present species increases the total number of *Eurydice* species to 54 with a range extending across the Pacific Ocean (13), Indian Ocean (17), North and South Atlantic Oceans (19) and the Mediterranean (10 species). There is now confirmation that no Atlantic or Mediterranean species extend into the Red Sea. Dexter (1986–7, 1989) sur-

veyed the sand beaches of Israel and the Sinai Peninsula, together with those of the Egyptian Red Sea and found only *E. arabica* intertidally. This species originally described from Yanbu on the Saudi Arabian Red Sea coast, extends to the north western shores of the Arabian Gulf.

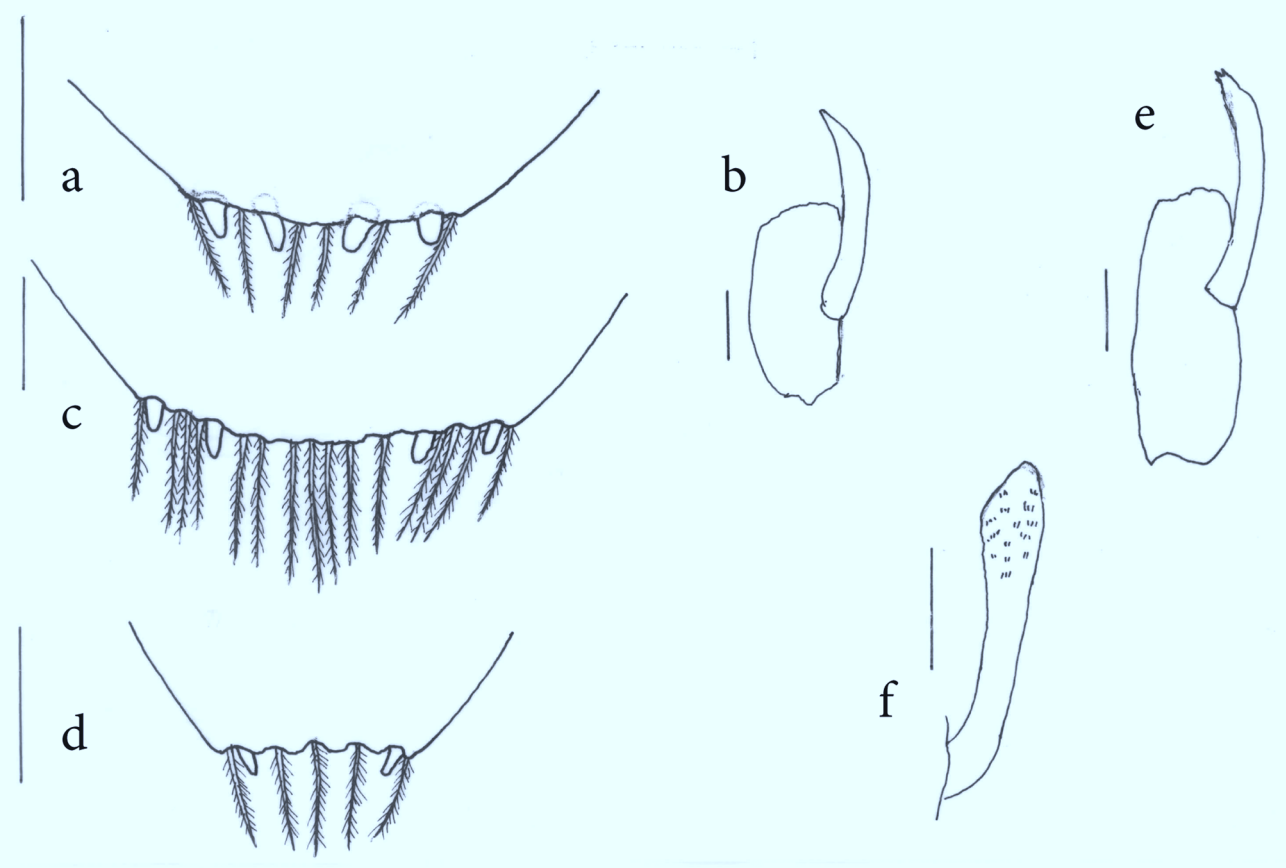

FIGURE 6. *Eurydice arabica* (SMF 40852): a, pleotelson posterior margin; b, appendix masculina; *Eurydice peraticis* (SMF 39707): c, pleotelson posterior margin; *Eurydice paxilli* (redrawn from Schotte & Kensley 2005): d, pleotelson posterior margin; e, appendix masculina; *Eurydice inermis* (redrawn from Bruce & Jones, 1978): f, appendix masculina. Vertical scale = 0.1 mm.

To date none of the South African or East African intertidal species (Jones 1971; Bruce & Soares 1996) have been found to occur in either the Red Sea or the Arabian Gulf. One Arabian Gulf species *E. peraticis* extends as far as the sand beaches of western India (Eleftheriou & Jones 1976), but the Indian species *E. indicis* has yet to be found in the Arabian region. Although this may appear to provide further evidence for the high level of endemism shown by marine isopods (Kensley 2001), the present distribution of intertidal *Eurydice* may simply reflect the collecting effort applied in certain areas. Similarly the occurrence of a single intertidal Red Sea species, as opposed to three species in the Arabian Gulf, may either be related to the seasonal tidal regime in the Red Sea (Jones 1984), or again to lack of collecting effort in the mid and south of the Red Sea.

Subtidal *Eurydice* species also show a high level of regional endemism although a few species such as *E. orientalis* have wider ranges (Bruce 1986). Present work confirms the absence of the Atlantic Mediterranean *E. inermis* with its tentative presence (Bruce & Jones 1978) now excluded by the recognition of the new species *E. tridentata*. Two of the subtidal species described here (*E. tridentata* and *E. marisrubri*) appear to be restricted to the Red Sea with a third species *E. marzouqui* occurring in the Arabian Gulf. No other Indian Ocean subtidal species have been found in either the Red Sea or the Arabian Gulf.

The four Eurydice species occurring in Kuwait exhibit between them all of the main adaptive morphological characters to habitat found in the genus elsewhere. Intertidal species have 2 (*E. paxilli*) or 4 (*E. peraticis, E. arabica*) robust setae on the posterior margin of the pleotelson, while these are absent in the subtidal species *E. marzouqui*. The latter species has elongated antennae reaching beyond the pereon while for intertidal species antennae are shorter, not extending beyond the pereon. *E. paxilli* is an extreme example within the genus with antennae not

extending beyond pereonite 1. Other species within the genus with only 2 robust setae on the pleotelson posterior margin, *E. barnardi* (South Africa) and *E. clymenia* (North Africa) have antennae of normal length. As the Arabian Gulf is only 15 thousand years old it would appear that the genus is capable of rapid regional diversification, as is seen in other crustacean groups within the Gulf region (Al-Khayat & Jones 1996; Apel & Türkay 1999).

Acknowledgements

The first author is grateful to Professor Fishelson University of Tel-Aviv, Israel, for provision of Red Sea material, and to ARAMCO, Dhahran, Saudi Arabia for Arabian Gulf collections. We are also grateful to La' Ala Al Kuwait Real Estate Co. K.S.C. for supporting the surveys at Sabah Al-Ahmad Sea City, Kuwait. Our thanks are also due to Ms. A. Priya, Marine Science Dept., Madras Christian College, Chennai, India for providing the map and finally Dr. Niel Bruce (Queensland Museum) for critically reviewing the manuscript.

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